LaSPACE Fall 2024 Council Meeting Student Poster Abstracts

"Measuring Acceleration and Gyroscopic Precession During Sounding Rocket Flight"

James Garcia | Southeastern Louisiana University (SELU) | SAFOS | Poster #1
Presenting Team Members: James Garcia, Physics

Our payload, ROOMIE-8 (Remote Observations of Many Interesting Events-8), was launched to an altitude of 72 miles onboard the RockSat-C 2024 rocket. The ACC (accelerometer) experiment on ROOMIE-8 used an array of accelerometers to measure the dynamics of the rocket, focusing particularly on the "high tumble" phase of re-entry, when the accelerometers measure an oscillation of +/- 15 g. Our hypothesis was that the rocket body, which spins for stability during ascent, was precessing during re-entry. Our post-flight analysis shows that this was not the case. Instead, the rocket body is experiencing a linear deceleration of 12 g, which oscillates in the frame of the instrument due to the rocket's spin. This conclusion is supported by radar tracking of the rocket's flight, which shows that the high-tumble phase corresponds with the deceleration of the rocket during re-entry. Understanding the dynamics of objects as they re-enter the Earth's atmosphere is important for managing their safe recovery.

"Assessment of Lake Salvador Shoreline Dynamics to Support Restoration of Submerged Aquatic Vegetation in Jean Lafitte National Historical Park and Preserve, Louisiana"

Lydia DiPaola | University of New Orleans (UNO) | GIRAF | Poster #2
Presenting Team Members: Lydia DiPaola (Biological Sciences)

The Deepwater Horizon disaster in 2010 led to the loss of 83% (50 acres) of submerged aquatic vegetation (SAV) along the shoreline of Lake Salvador adjacent to Jean Lafitte National Historical Park and Preserve (JELA). SAV beds serve critical ecological functions such as providing food and shelter for wildlife, filtering contaminants, decreasing wave energy and stabilizing sediments. SAV loss degrades essential wildlife habitat and increases coastal erosion. Planning phase studies indicated that wave energy not water quality deters SAV establishment and growth in the project area. In response, JELA constructed a breakwater barrier to create low energy SAV habitat. In collaboration with JELA contractors, this study will analyze water quality, wave action, SAV and nekton community data to support JELA's project goals to restore 50 acres of SAV landward of the barrier and reduce shoreline erosion. Sampling occurred July 2022, October 2022, November 2023, and August 2024 and will continue October-November 2024. To assess recent historical shoreline dynamics and consequences for SAV habitat area, shoreline data will be extracted from Sentinel-2 imagery (2017-2024) to track change over time and classify shoreline areas that are more vulnerable. Initial findings indicate that construction activities have a short-term impact of increased turbidity, and that since 2017, the shoreline-adjacent marsh area has decreased by approximately 0.241 km2. This study will inform JELA project managers of environmental conditions and guide similar future restoration projects.

"Solar-Aided UAV for Enhanced Flight Duration and Experimental Learning"

Houston Akridge | University of Louisiana at Lafayette (ULL) | Senior Design | Poster #3
Presenting Team Members: Houston Akridge, Chloe Williamson, Evan Dardar, Ali Khan

This project, aims to extend the capabilities of unmanned aerial vehicles (UAVs) through the integration of solar-powered foldable wings, contributing to NASA's vision of innovative aerospace technologies. Capitalizing on the outcomes of our previous 2022-23 senior design project, which developed a distributed control algorithm, our team of 2-4 undergraduate students will work on a two-semester design in the 2024-25 academic year to augment an open-source, off-the-shelf drone with 3D-printed, solar-covered wings. The project's technical goal is to significantly extend the UAV's flight duration by harnessing solar energy, thereby reducing the reliance on traditional battery power and enhancing the sustainability of UAV operations. To achieve this, we will design and implement a new control system tailored to the modified UAV architecture, ensuring stability and performance in the solar-augmented flight regime. This inclusive and interdisciplinary project will serve as an experimental testbed, fostering hands-on learning experiences in solar technology, materials science, additive manufacturing, control systems, and power management. The initiative aligns with NASA's strategic interests in advancing solar power applications and autonomous systems, while also promoting educational objectives by providing a practical platform for undergraduate students to engage in cutting-edge aerospace research and development. Through this project, we aim to lay the groundwork for a larger-scale platform that will enrich experimental learning and inspire future innovations in solar-assisted flight technologies.

“Design and construction of an LED circuit for optimizing emission from luminescent materials”

Gavin Soniat | Louisiana Tech University (LaTech) | Senior Design | Poster #4
Presenting Team Members: Gavin Soniat (EE) John Sibley (PHYS) Jake Stelly (EE)

One of NASA’s current aims is to facilitate interplanetary travel between Earth and Mars. When space crew are required to travel for extended periods outside of low Earth orbit, several challenges arise. These challenges include: reliable lighting for general use and displays, radiation detection, growing of food sources, medical care including wound healing and ensuring that the crew’s Circadian Rhythm is regulated. Light Emitting Diodes (LEDs) can tackle many of these challenges in a low-cost manner. Our research group has investigated and synthesized many luminescent compounds based on lanthanide complexes or small organic molecules. These new compounds have been doped into low weigh organic polymers to afford machinable luminescent polymer materials. However, our group has yet to incorporate these luminescent polymers into actual devices. Herein, we look to obtain an actual lighting device using our polymers. One issue with creating so many unique compounds that have unique optical properties is that each one has to be carefully characterized which can take several hours of trial and error to find the optimal excitation wavelength. We intend to create a device that probes a novel compound with multiple LED lasers to quickly find the optimal wavelength. A secondary goal of the device is to compare the resulting spectra against a database of known compounds and predict an optimal excitation wavelength for a given structure.

“Robotic additive manufacturing system”

Emily Walls | Southeastern Louisiana University (SELU) | Senior Design | Poster #5
Presenting Team Members: Colby Pickett (Mechatronics), Dylan Walker (Mechanical), Emily Walls (Computer/Mechatronics), Holden Kareokowsky (Mechatronics)

NASA has been actively evaluating additive manufacturing (AM) technologies for off-earth manufacturing purposes. While the ongoing projects are providing valuable insights on capabilities of AM through technology demonstrations, it is also important to note that the equipment, devices, and materials need to be transported to the end use location be it International Space Station (ISS) or off-earth locations (e.g., Moon, Mars etc.). Therefore, it is important to maximize equipment utilization and optimize launch payload weight for such technologies. The current 3D printers are restricted to planar movement for material extrusion which results in slower cycle times due to the need of support materials for printing complex geometries. These support materials need to be removed before the printed object can be used as an end use part. However, it is not practical to bring all the required support material due to payload space and weight limitations. For future use case scenarios, printing capabilities will have to be enhanced through implementation of non-planar 3D printing for maximizing equipment utilization and minimizing wait times. This can potentially be demonstrated using a robotic additive manufacturing system (RAMS) which integrates a 6-axis robot with a material extruder as the end effector. This research will design, develop, and demonstrate a robotic additive manufacturing system that will leverage on the benefits of six degrees-of-freedom of industrial robots, thus providing a proof-of-concept for an all-in-one multipurpose large-area high throughput AM platform.

“Wavelength Conversion Materials for Solar Cell Efficiency”

Eniola Irinoye | Grambling State University (GSU) | Senior Design | Poster #6
Presenting Team Members: Eniola Irionye, Joseph Oduyebo

Quantum dots are nanocrystal semi-conductor particles just a few nanometers in size that have both optical and electrical properties. Hence, they have the capability to be incorporated into increasing the efficiency of photovoltaic (solar) cells. Photovoltaic cells make up what is known as solar panels. A photovoltaic cell is essentially a p-n junction that absorbs light, releases electrons and holes that therefore creates an output voltage. The current absorption spectrum of PV cells ranges from 400nm-1100nm, not utilizing infrared or ultraviolet light. Implementing a Quantum Dot wavelength conversion film could increase lower wavelength intensities to those that could be absorbed by the solar cell. Increasing the wavelength spectra that current is generated from through creation of a quantum dot film would increase the efficiency of the overall cell. The technique proposed for implementing this film is to sandwich a QD solution between two glass slides held by the surface tension of various liquids. This arrangement will serve as a film for the PV reference cell that receives light from a solar simulator light source in which results will be discussed.

"Simulation of space radiation-induced double-strand breaks with CRISPR/Cas genome editing in the brain to evaluate the risk of cognitive decline and neurodegeneration during human spaceflight missions to Mars"

Katelyn Lofton | Louisiana State University Health Sciences (LSUHSC) | GSRA | Poster #7
Presenting Team Members: Katelyn Lofton (Pharmacology, Toxicology & Neuroscience)

Space travel presents tremendous environmental challenges to spaceflight crews, including galactic cosmic radiation (GCR) and microgravity. It is well known that space radiations can induce DNA damage, mutations, and chromosomal aberrations that are difficult to repair. Among a variety of space radiation-induced DNA damage events, double-strand breaks (DSBs) have the most critical pathogenic consequence. Given the plethora of correlational evidence describing neurodegenerative disorders in which levels of DNA damage were identified, the most critical question is the extent to which the significance of DNA damage has relevance for the pathogenesis of neurodegeneration. To address the pathogenic role of space radiation, we reason that one of the main hurdles is the lack of an in vivo tool with sufficient spatial or temporal resolution and sensitivity to track neurons with increased DNA damage response after space radiation exposure. In order to overcome these hurdles, a neurotropic genome editing approach was developed in our lab for the noninvasive generation of a double-strand break in mouse brains with a wide-scale and dose-dependable genome editing footprint in adult mouse brains. We could generate persistent DSBs in the safe harbor locus (Rosa 26) precisely in different percentages of neuronal cells in vivo. The DSBs in the safe harbor locus will increase DNA damage response but not genomic mutations with pathologic consequences. Furthermore, our strategy facilitates the development of a genetic strategy to reduce overactivated DNA damage response selectively in DNA damage-burdened cells as a countermeasure.

"In Silico Design and Synthesis of Anti-Inflammatory Peptides to Mitigate Oxidative Stress-Induced Neuroinflammation"

Dale Major | Louisiana Tech University (LaTech) | GSRA | Poster #8
Presenting Team Members: Dale Major (Molecular Sciences and Nanotechnology)

Neuroinflammation, driven by oxidative stress, is a crucial contributor to various neurodegenerative diseases. MK2, a downstream effector in the p38/MAPK signaling pathway, is critical in promoting inflammatory responses. In this study, we designed two novel anti-inflammatory peptides, AIP-1KA and AIP-1KN, to target MK2 and mitigate oxidative stress-induced neuroinflammation. Molecular docking studies revealed that both peptides exhibit strong binding affinities to MK2, with slight variations in their interactions and binding energies. The peptides were successfully synthesized using solid-phase (SPPS) synthesis and characterized via FTIR, UV/Vis, and MALDI-TOF, confirming their structural integrity and purity. These findings support the potential of AIP-1KA and AIP-1KN as therapeutic candidates for reducing neuroinflammation. Future studies will evaluate their effectiveness in cell uptake, ROS assays, and cytotoxicity testing through MTT assays to further assess their potential as safe and effective treatments for neuroinflammatory conditions.

"Measuring Ozone as a Function of Ultraviolet Light"

Nathaniel Wrobel | Louisiana State University and A&M College (LSU) | HASP, GPS | Poster #9
Presenting Team Members: Nathaniel Wrobel (Mechanical Engineering)

Ozone protects life on Earth from damaging ultraviolet rays, emitted from the sun, through photolysis. To better understand the relationship between ozone molecules and UV, a payload will be sent to a high altitude where stratospheric ozone is present. To find a correlation between UV intensity and ozone concentration, the payload will include photosensors to measure the UV radiation, referencing the designs from J.A.A.C Flight FRR 2023 and the LSU COMPASS HASP 2022 missions, and an ozone detector. The payload will also include an IMU to determine the ultraviolet sensor's orientation. A high-altitude balloon flies to the necessary altitude for collecting ideal ozone and UV data at the top of the ozone layer. Information gained from this study will help us build a model for the concentration of ozone present under various intensities of UVA, B, and C, and this will help us to better understand the photolysis reaction of ozone under high energy solar radiation. Future studies can expand upon this information to find a limit to how much ozone will need to be present before a harmful amount of solar radiation reaches the Earth's surface.

"UV Spectrum of the Corona vs. Photosphere"

Caroline Davis | Louisiana State University and A&M College (LSU) | LaACES | Poster #10
Presenting Team Members: Caroline Davis (Physics); Joyce Oluwaseun (Mechanical Engineering)

The photosphere and corona of the sun have different emission characteristics based on temperature and density. Due to its higher temperature, the peak of the corona is closer to the X-ray band while the peak of the photosphere exists in the visible light band. However, photosphere's emission spectra are much more intense due to a higher relative density. This difference in intensities makes it challenging to take measurements of the corona during normal circumstances. Team TIGERS has taken part in the LaACES ballooning project funded by LASPACE. Team TIGERS has designed a ballooning payload that measures the intensity within the UVA, UVB, and UVC bands. At the altitude of 80,000ft, it is possible to observe shorter UV bands since the payload will be partially above the ozone layer. The intention was to launch during the eclipse so that the corona could be observed. Unfortunately, Team TIGERS was unable to launch during to the eclipse due to the projected landing being within the DFW area, but later launched in normal flight conditions.

"Apples to Apples: A SkeeterSat Calibration Comparison Between Delgado Team Members"

Josef Hightower-Hinnawi | Delgado Community College (DCC) | LaACES | Poster #11
Presenting Team Members: Josef Hightower-Hinnawi, Ella Gottschalk, Courtney Nero

Delgado Community College students are participating in the Louisiana Aerospace Catalyst Experience for Students (LaACES). The first instrument calibration we will perform is on a device that emits a variable noise frequency as temperature changes called a SkeeterSat. We plan to vary the calibration technique for each student on each device and compare the results across the class. We hope the experiment will enable us to create a more efficient calibration process for future teams. We plan to vary audio software, temperature measurements, and comparative temperature instruments. Additionally, we expect to see differences in the trouble shooting procedures that will occur due to faulty soldering or electrical components.

"TinyML4WaterQ: Enabling Mobile Spectrophotometric-based Characterization of Water Quality Using Machine Learning Models Embedded in Light-weight Edge-computing Device"

Carly Broussard | University of Louisiana at Lafayette (ULL) | LaSSO | Poster #12
Presenting Team Members: Carly Broussard (CHEME)

The project focuses on the development of an edge-computing device running a machine learning model that implements Spectrophotometric-based characterization of water quality. The first alignment is with NOAA's Louisiana Sea Grant (LSG) research priority 'A. Focus Area: Healthy Coastal Ecosystems' under the specific task 'Develop and share scientific understanding, decision-support tools, technologies and approaches to protect, restore and improve water quality in Louisiana's wetlands, rivers and estuaries.' Creating a spectrophotometric-based water quality measurement device available not only in a laboratory setup but also as a mobile on-field deployment light-weight hardware at very low cost will allow many types of agencies and individuals involved in water and coastal works and business to efficiently do their part in improving the health of coastal ecosystems in the state of Louisiana. The second alignment is with NASA Science Mission Directorate Earth Sciences Division (ESD) research focus area of 'Water and Energy Cycle (WEC)' . WEC focus area helps improve the understanding of the dynamics of water on Earth including water quality. The proposed edge-device 'TinyML4WaterQ' will be an additional tool in this task of ESD as the device enables decentralizing water quality assessment and it may encourage the participation of more individuals due to its low-cost and mobile nature.

"The 2024 Solar Eclipse Ballooning Project: 60 launches in 30hrs"

Dre'Shawna Bradley | Delgado Community College (DCC) | LaACES | Poster #13
Presenting Team Members: Dre'Shawna Bradley, Sujit Mainali, Arnab Bhatta

Delgado Community College, Dillard University and University of New Orleans students participated in the Atmospheric Science team of the Nationwide Eclipse Ballooning Project in the 2023-2024 Academic year. The teams were tasked with launching weather balloons hourly for 30 hours over the duration of the eclipse. As a double team, Delgado and Dillard were tasked with alternating launches every 60 minutes for 30 hours. Due to the challenges faced at the annular eclipse, several team members were added just before the total eclipse on April 8th 2024. This poster is presented by students were trained weeks or hours before the field campaign, covering their experience of the 30-hour project.

"Investigating the Synthesis of Copper Sulfate By Electrolysis: A Machine Learning Guided Approach"

Elijah Precciely | Southern University and A & M College (SUBR) | HIS / Timbuktu Academy | Poster #14
Presenting Team Members: Elijah Precciely/ Physics

A recommendation system for optimizing copper sulfate yield can analyze the relationship between voltage, current, concentration, and the length of wire used in the electrolysis process. By leveraging historical data and machine learning algorithms, the system can suggest optimal parameter settings to maximize yield and efficiency. Continuous monitoring and feedback allow the system to adapt recommendations based on real-time variations in production conditions.

Initial studies suggest that an anode weight between 5.513g - 5.864g and a reaction time between 60 - 80 min was the most optimal for yield. In future studies we will explore in more depth the role of current in they synthesis of copper Sulfate.

"Asymmetric Tunneling of BEC"

Dusty Lindberg | Tulane University (Tulane) | NASA EPSCoR | Poster #15
Presenting Team Members: Dusty Lindberg (Physics)

In his celebrated textbook, Quantum Mechanics: Nonrelativistic Theory, Landau argued that, for single particle systems in 1D, tunneling probability remains the same for a particle incident from the left or the right of a barrier. This left-right symmetry of tunneling probability holds regardless of the shape of the potential barrier. However, there are a variety of known cases that break this symmetry, e.g. when observing composite particles. We computationally (and analytically, in the simplest case) show this breaking of the left-right tunneling symmetry for Bose-Einstein condensates (BEC) in 1D, modelled by the Gross-Pitaevskii equation (GPE). By varying g, the parameter of inter-particle interaction in the BEC, we demonstrate that the transition from symmetric ($g=0$) to asymmetric tunneling is a threshold phenomenon. Our computations employ experimentally feasible parameters such that these results may be experimentally demonstrated in the near future. We conclude by suggesting applications of the phenomena to design atomtronic diodes, synthetic gauge fields, Maxwell's demons, and black-hole analogues.

“Gene Sampling Technology for Rapid Microbial Lysis and Genotyping in Microfliuidic Device”
Md Aminul Islam | Louisiana Tech University (LaTech) | NASA EPSCoR R3 | Poster #16
Presenting Team Members: Md Amunil Islam (PhD MSNT)

This study reports on designing and characterizing a lab-on-a-chip piezoelectric platform for purifying bacterial lysis and nucleic acid. This device platform enables the isolation of bacterial RNA for subsequent gene expression analysis. The lysis efficiency of mechanical, enzymatic, and ultrasonic methods was assessed using gram-positive (B. cereus) and gram-negative (E. coli) bacteria. Ultrasonic lysis was the most efficient method resulting in an average of 502ng of RNA from 1^107 B. cereus. Mechanical lysis provided the highest yield for gram-negative bacteria at an average of 2,438ng of RNA from 1^107 E. coli. Lysis efficiency testing was done using LIVE/DEAD™ bacterial viability fluorescence assay. The design of the microfluidic platform includes piezoelectric plates (25mm×5mm×0.3mm) for disruption of bacterial cell walls. The device was fabricated using a Form 3 printer and Formlabs clear V4 resin. The platform dimensions were 35mm×28mm×10mm. The lysis efficiency for E. coli ranged from 40% to 70% at 15 and 45 minutes respectively. The platform was successfully functionalized with E. coli-specific aptamer for selective bacterial enrichment. A gold-plated pin (200μm×25mm) was functionalized with thiol-conjugated synthetic RNA capture sequences for selective purification of bacterial 16S RNA. The nucleic acid material selectively binds to the pin after at least 2 minutes of incubation in the bacterial lysate. The RNA capture pin efficiency was 60ng of RNA per pin using E. coli and 28ng per pin using B. cereus.

“Development of an Acoustic Levitator”
Isaiah Parfait | University of Louisiana at Lafayette (ULL) | NASA Summer Intern | Poster #17
Presenting Team Members: Isaiah Parfait (Mechanical Engineering)

As NASA travels back to the moon, it is important to learn to utilize the materials on its surface for our manufacturing needs. Acoustic Levitation is one method being explored to harvest any useful materials such as metals from the powder on the lunar surface. This project is being developed in the Materials Levitation Lab in Huntsville, Alabama at the Marshall Space Flight Center. The end goal of this project is to implement other methods such as electro-magnetic or electro-static manipulation of powder particles to sort them as desired. This levitator has also been used to conduct container-less crystallization studies on things such as salt water. The summer was spent developing the capabilities and mechanical systems of the levitator. A comprehensive 3D model was created of the system, a motorized loading mechanism was created for ease of testing, and a system for separating metallics from lunar regolith was designed.

“Capturing Supernovae Neutrinos”
Justin Mitchell | Southern University A&M College | HIS / Timbuktu Academy | Poster #18
Presenting Team Members: Justin Mitchell/ Physics

Through the processes of a particle simulation program, I plan to use a model version of a detector located 1400-2400 meters beneath the Antarctic Ice of the South Pole, and spans about 1 cubic kilometer wide. Using this model, I can accurately depict simulations that we can obviously not observe happening in the atmosphere and inside of the phenomena of supernovae. Using these near massless particles as a source of information, we can further our knowledge of astronomical phenomena.

“Integrating the BeppoSAX Mission Into The InterPlanetary Network Gamma-Ray Burst Catalog”
Emily Reily | Louisiana State University and A&M College (LSU) | LURA | Poster #19
Presenting Team Members: Emily Reily (Physics)

Studying gamma-ray bursts (GRBs) is essential to advancing high-energy astrophysics and the rapidly growing field of time domain and multi-messenger astronomy. Since the 1970s, numerous catalogs documenting GRBs have been published, each with parameters unique to the given detector. This means most catalogs do not share the same naming methods, trigger time formats, and other important values associated with their respective energy bands. To reconcile these differences, Dr. Eric Burns is leading the creation of a collated GRB catalog. My work contributes to this larger project by integrating the BeppoSAX Gamma-ray Burst Monitor (GRBM) catalog which consists of over 1000 GRBs detected between 1996-2002. To do this, I largely use the Python programming language to manipulate and store large data sets. I also use several Python packages and functions unique to gamma-ray data analysis to create sky map localizations, produce bolometric fluence and peak flux values, identify recorded redshifts, and then use these values to calculate isotropic energies and luminosities. This project has exponentially enhanced my knowledge of how high-energy transient events are detected and studied. Ultimately, my contributions, alongside those of the PI, Dr. Eric Burns, and software engineer, Courey Elliott, will produce a single GRB resource equipping physicists all over the globe to conduct more efficient research.

“Ultralight Solar Cells for Space-Based Power”

Owen Harris | Tulane University (Tulane) | LURA | Poster #20
Presenting Team Members: Owen Harris (Materials Science and Engineering)

As the number of satellites launched to orbit rapidly grows, developing lighter, more economical space-based solar power systems is a crucial and expanding area of interest. Two-dimensional materials like molybdenum disulfide (MoS2) are an exciting class of materials that can have strong absorption at nanometer-scale thicknesses. Since the cost of power on orbit is dominated by the weight of the payload, these nanometer-thin materials have potential to be ultralight photovoltaic (PV) cells of the future for space-based applications. We demonstrate the fabrication of ultralight PV cells made from MoS2 on flexible polyimide and compare the relevant technoeconomic metrics of a modeled device to industry standard silicon. We find that an improved and scaled solar array of 2D-material-based PV cells outperform silicon in specific power density (W/kg) and cost ($) per Watt. Future improvement of these devices centers around optimizing the device architecture and packaging techniques, as well as the exploration of different 2D materials to construct heterostructure junctions.

“Deciphering Gamma-ray Blazars Duty Cycle to Inform Polarization Studies with the Future NASA Mission COSI”

Garrett Latiolais | Louisiana State University and A&M College (LSU) | LURA | Poster #21
Presenting Team Members: Garrett Latiolais (Astronomy)

Blazars are Active Galactic Nuclei (AGNs) with relativistic jets pointing towards Earth, making them prolific gamma-ray sources observed by the Fermi Large Area Telescope (LAT). These sources exhibit significant variability across the electromagnetic spectrum, especially in gamma rays, reflecting changes in jet density and magnetic configuration. Long-term monitoring of gamma-ray emission from blazars is crucial for understanding the physics of AGN jets. The Light Curve Repository (LCR) is an extensive database that collects light curves of over 1500 sources detected by the LAT, most of which are blazars. The LCR serves as a vital resource for conducting systematic studies of blazars on a population level, enabling the analysis of their variability and duty cycles. This project will leverage the LCR to investigate the duty cycle of different blazar sub-classes, such as flat-spectrum radio quasars (FSRQs) and BL Lacs. By utilizing the LCR's comprehensive data, the research aims to develop analysis pipelines and establish detection expectations for the upcoming NASA SMEX COSI mission. COSI, a wide-field gamma-ray telescope, will survey the sky at 0.2-5 MeV, providing imaging, spectroscopy, and polarimetry. Understanding the frequency, duration, and brightness of blazar flares necessary for COSI's polarization sensitivity is the project's main objective, ultimately preparing the scientific community to fully exploit COSI’s capabilities.

“The Effects of Microgravity on Serotonin in the Brain”

Carl Robbins | Louisiana Tech University (LaTech) | LURA | Poster #22
Presenting Team Members: Carl Robbins (Biomedical Engineering)

Human space exploration demands a deeper understanding of the health risks posed by the spaceflight environment. Microgravity presents a challenge that can disrupt human physiology during space missions, necessitating adaptive responses from the body to maintain brain homeostasis. Astronauts exposed to spaceflight conditions often experience alterations in behavior and cognitive functions, including changes in spatial orientation, sensory processing, social interactions, learning, memory, and mood regulation. Serotonin (5-hydroxytryptamine, 5-HT), a key neurotransmitter in the central nervous system, plays a pivotal role in regulating various physiological functions crucial for astronaut well-being, from mood and cognition to appetite and sleep. This project aims to use a previously developed key technology to investigate how gravity impacts serotonin levels in the mouse brain. This technology consists of poly(3,4- ethylenedioxythiophene)/carbon nanotube (PEDOT/CNT) coated glassy carbon (GC) microelectrode arrays (MEAs), that has been shown to enable selective 5-HT measurement in combination with an optimized square wave voltammetry (SWV) electrochemical technique. In this study, we will present the potential of our technology in enhancing our understanding of 5-HT levels under microgravity, which is not only pivotal for safeguarding astronaut mental health but also holds implications for developing countermeasures.

"Investigation of mechanical properties of 3D printed materials under dynamic loads"

Daniel Ayala | Southeastern Louisiana University (SELU) | LURA | Poster #23
Presenting Team Members: Daniel Ayala (Mechanical Engineering Technology)

Additive manufacturing technologies are evolving and allowing a more sophisticated matrix of new materials with improved mechanical properties to be introduced. However, ensuring the consistency and reliability of 3D printed materials poses a challenge. With the high dynamic load to which many components are exposed, it is not the static breaking point but the fatigue limit which decides when a fracture occurs. Fatigue strength is thus of great significance in design.The lack of research in the effect of 3D printing parameters on the durability of products in terms of fatigue strength puts an emphasis on pursuing new studies. This work provides an investigation of the influence of 3D printing parameters on fatigue behavior. In this study, the mechanical properties of PLA, nylon reinforced with fibers and 3D-printed resin material are investigated. A Markforged-Two carbon fiber reinforcement printer and a LCD Phrozen Sonic MEGA 8K V2 resin printer are the primary 3D printers utilized. Fatigue specimens were designed by altering ASTM standards to adapt to the strain sensitivity of the fatigue testing machine's load cell.The current research is still in the initial stages; The TERCO MT3012-E fatigue testing machine, an apparatus originally designed for metal fatigue testing, will be used. Modifications to the rotary bending fatigue machine are taking place to reconfigure strain gauges, decrease the minimum force limit and stabilize the applied load thus allowing testing of polymers rather than metals. This project directly addresses the need for detailed understanding of the mechanical properties of 3D printed material.

"Investigation of the Degradation of Mechanical Properties of 3D Printed Materials Under Thermal Loads"

Abigail Gillis | Southeastern Louisiana University (SELU) | LURA | Poster #24
Presenting Team Members: Abigail Gillis (Mechatronics Engineering)

In this project, the degradation of mechanical properties of 3D printed parts experiencing thermal cyclic loads is investigated. The project is sponsored by Louisiana Space Grant Consortium (LaSPACE) through their program Louisiana Undergraduate Research Assistantship (LURA). The scope of the project includes the study of the effect of various thermal loads on the tensile strength of the commonly used 3D printing material polylactide (PLA). Using the results achieved by the previous research group along with Initial experiments, the best printing parameters were determined. These parameters include printing orientation, infill pattern, percent infill, as well as other printer specific settings. The American Society for Testing and Materials (ASTM) standards were followed to prepare and test the tensile test specimens on a vertical ADMET tensile testing machine. Thermal loads will be applied in different magnitudes and durations. The temperature ranges will be 15, 30 and 45 °C with starting low temperatures of -15, 0, 15, and 30 °C. A thermal cycle will consist of 1 interval of low temperature followed by an interval of a higher temperature and repeated for up to six times. The duration of each temperature will be 10 minutes, one hour, and one day. Control specimens will be kept at room temperature and their strength will be evaluated and compared to different batches of specimens subjected to the aforementioned thermal loads.

"Insights into the impacts of continuous, low dose-rate neutron radiation exposure on fetal skeletal development"

Catherine Sorrels | Louisiana State University and A&M College (LSU) | LURA | Poster #25
Presenting Team Members: Catherine Sorrels (Kinesiology)

The combined effects of space environmental stressors cause multiple organ system pathologies. Specifically, musculoskeletal system pathologies will be very dangerous for the health and performance of astronauts on extended-duration missions beyond low-Earth-orbit (LEO). To enable extended-duration missions beyond LEO or setting up settlements off Earth, we need to better understand the impact of continuous radiation exposure on mammalian physiology. There is a critical gap in knowledge surrounding the impact of the space radiation environment on skeletal health and fetal skeletal development. In this LURA project, we will extend the use of mouse fetal samples from a NASA Space Biology grant examining the effects of continuous neutron radiation exposure during pregnancy on maternal and fetal skeletal physiology. The parent study placed recently mated female mice into housing in the Colorado State University neutron irradiator. Animals were exposed to high-energy neutron particles (1mGy/day) for 23 hours/day. Following either 12 or 18 days of radiation exposure, the maternal hindlimb bones and all fetal tissues were collected and stored for later analysis. All animal work for the parent study was completed in 2019. For this LURA we proposed to extend the understanding we can gain from the gestational day 18 fetal samples by sending them to NASA Ames for microCT analysis at a better resolution than possible at our home institution. The raw images will be returned to our team to complete the analysis. We will obtain information regarding differences in overall mineralization and skeletal formation between the control and radiation groups.

"TinyML4Heart: Realtime Early-Detection of Cardiac Arrest Risk Using Machine Learning in Embedded Edge-Computing Device"

Renee Ward | University of Louisiana at Lafayette (ULL) | LURA | Poster #26
Presenting Team Members: Renee Ward

The project focuses on the development of an edge-computing device running a machine learning model that implements realtime early-detection of cardiac arrest risk. The project is primarily aligned with the focus area by the Human Research Program (HRP) under the Space Operations Mission Directorate (SOMD) at NASA. HRP focuses on research to develop methods to protect the health and performance of astronauts in space. Human health monitoring during various activities in space missions and even on the ground is integral in the various risk assessment tasks done by HRP. HRP has identified gaps as part of the roadmap of the program. This project proposes to contribute to filling this gap on the cardiac monitoring while at the same time adds the capability of predicting on-set of serious cardiac arrest.

"Advancement of Thermoelectric Technology by Synthesis of Suitable Materials."

Jacko Xiao | Louisiana State University and A&M College (LSU) | LURA | Poster #27
Presenting Team Members: Jacko Xiao (Chemical Engineering)

The purpose of this project is to develop materials with thermoelectric properties viable for thermoelectric application. The thermoelectic effect refers to the conversion of the difference in temperature into electric energy. Materials with thermoelectic properties exhibit the conversion of heat into electricity. NASA can use thermoelectric materials to convert excess heat into more power, increasing the efficiency of all their technologies. The current focus of this project is the study of Eu2As3, a newly synthesized compound. The Eu2As3 Zintl phase discovered in Dr. Baranets' lab has scarce data regarding its properties and structure. Measurement of its thermoelectric properties and structure will assess its viability for future thermoelectic application.

"High Quality Transfer of Monolayer MoS2 for High-performance Optoelectronic Devices"

Joshua Sasson | Tulane University (Tulane) | LURA | Poster #28
Presenting Team Members: Joshua Sasson (Engineering Physics and Computer Science)

The development of scalable high-quality transfer techniques for 2D materials, such as MoS_2, holds significant potential for enhancing the quality of desired optoelectronic devices, particularly in applications like space solar power. Current methods, specifically PMMA assisted transfer methods, use materials that require cleaning with harsh solvents and leave large amounts of residue that diminish performance of completed devices and are slower than needed to attainably create devices that require many stacked layers. This project aims to innovate layer stacking methodologies to improve the performance and scalability of 2D MoS_2 films by reducing reliance on harsh solvents, using materials that leave less residue, all while being done significantly faster. The results of the new transfer method will be compared to other methods using absorption mapping plots of polymer residue, photoluminescence scans of transferred films, and optical imaging. The main deliverable is a transfer process that enables 10 film transfers in under two hours while maintaining 80% of optoelectronic properties. If successful stacks of these materials could one day end up in high-performance lightweight optoelectronic devices in space.

"Developing a Hot Extrusion Rig for Metallic Materials"

Brenden Cormier | Southern University and A & M College (SUBR) | FFP+SURF 2024 | Poster #29
Presenting Team Members: Brenden Cormier (Mechanical Engineering), Owen Thierry (Mechanical Engineering)

Information not submitted.

"Reducing the risk of brain tumor development in astronauts post-spaceflight: mass spectrometry-based proteomic analysis of glioblastoma-derived extracellular vesicles"

K. Hope Hutson | Louisiana Tech University (LaTech) | REA | Poster #30
Presenting Team Members: K. Hope Hutson (Molecular Science and Nanotechnology)

Astronauts are exposed to high levels of ionizing radiation during spaceflight, increasing their risk of developing glioblastoma brain tumors. With only a 5% survival rate following glioblastoma diagnosis, it is crucial to identify methods for earlier diagnosis of the disease. Extracellular vesicles (EVs) are released by donor cells and encapsulate RNA, DNA, and proteins that influence gene and protein expression upon uptake by recipient cells. Transcriptomic and proteomic cell alterations have been associated with the development and progression of glioblastomas. This study aims to identify EV-derived glioblastoma biomarkers through a comparative mass spectrometry-based bottom-up proteomic analysis of glioblastoma LN-229 cell line and healthy human neurons, astrocytes, and endothelial brain cells (HEBC), therefore, advancing the understanding of the underlying mechanisms of disease progression and paving the way for the development of liquid-biopsy-based noninvasive diagnostic approaches. Data analysis was performed using Spectronaut software (version 18.3, Biognosys) for processing mass spectrometry data. Comparative analysis of astrocytes and LN-229 EVs showed that the glioblastoma fraction displayed an average of 1,499 proteins. The proteomic profile of human astrocyte-derived EVs featured 1,301 proteins. A total of 48 proteins showed statistically significant upregulation in glioblastoma EVs compared to human astrocytes. A subset of 13 proteins are associated with glioblastoma tumorigenesis and metastasis. Analysis of EVs derived from both glioblastoma and healthy human astrocytes, neurons, and HEBC was performed to identify biologically significant biomarkers. A subset of 20 proteins was identified as potential biomarkers of glioblastoma. This study sheds light on the role of EVs in glioblastoma progression and metastasis, and their biomarker's potential for early detection and targeted therapeutic interventions to help mitigate the risk of glioblastoma development in astronauts.

"Fabrication of High-Sensitivity Nanofiber-Based Glucose Sensor for Non-Invasive Health Monitoring in Space Tourism"

Abdullah Ahmed | University of Louisiana at Lafayette (ULL) | REA | Poster #31
Presenting Team Members: Abdullah Ahmed (Chemical Engineeering)

As space tourism becomes increasingly feasible, continuous and non-invasive health monitoring is essential for ensuring the well-being of space travelers. In this study, we present the development of a high-sensitivity glucose sensor based on electrospun nanofibers, optimized for use in the unique environment of space. The sensor is designed to monitor glucose levels non-invasively through sweat, providing a crucial health metric for space tourists. The sensor utilizes a polyaniline (PANI)-based nanofiber matrix doped with sulfuric acid to enhance electrical conductivity, coupled with a Nafion coating for selectivity. The Nafion layer allows glucose and hydrogen peroxide to permeate while blocking interferents such as salts and proteins commonly found in sweat. Gold nanoparticles (AuNPs) are incorporated to further enhance the sensitivity of the sensor by improving electron transfer. Glucose oxidase (GOx) is immobilized on the nanofiber surface to catalyze the oxidation of glucose, providing a measurable electrochemical signal that correlates with glucose concentration in sweat. This sensor is specifically designed for use in the extreme conditions of space, including varying temperatures and microgravity environments. It is lightweight, flexible, and can be integrated into wearable health-monitoring devices. The system provides real-time, continuous monitoring of glucose levels, ensuring the health and safety of space tourists without the need for invasive blood sampling. The development of such non-invasive health monitoring technologies is critical to support long-duration space travel and the commercial space tourism industry.

"A Mechanistic Investigation of Catalyst Stability for Producing Liquid Rocket Propellant Fuels"

Caroline Cresap | Louisiana Tech University (LaTech) | REA | Poster #32
Presenting Team Members: Caroline Cresap (Chemical Engineering); Piper Smith (Biomedical Engineering)

Our research group's main research area is the catalytic conversion of methane to clean fuels (e.g., hydrogen) and value-added chemicals (e.g., methanol) via the discipline of catalysis science and reaction engineering. The principal goal of our LaSPACE REA projects is to explore the catalytic conversion of space-abundant methane (CH4) to kerosene-like hydrocarbons, which can be used as liquid rocket propellant fuels. The current small and large lunar landers are using methane or hydrogen, the conversion of methane into other hydrocarbons for fuel (kerosene, ethylene) is of interest to NASA in the long run. The activity, selectivity, and stability of a heterogeneous catalyst are three important metrics to consider when assessing its catalytic performance. In a continuous-flow reactor, catalyst stability describes the trend of losing its activity and/or selectivity with time-on-stream (TOS). Poor stability leads to rapid catalyst deactivation, which is a major concern in industrial applications of catalysts. As compared to the other two metrics (activity and selectivity), catalyst stability is less frequently investigated on a fundamental level; although it is a central metric in assessing the viability of a catalyst for industrial practice. In this project, we plan to conduct a mechanistic investigation of catalyst stability for producing liquid rocket propellant fuels from methane conversion.

"Autonomous Health Management System for Space Power DC Nanogrids"

Shayan Ebrahimi | University of Louisiana at Lafayette (ULL) | REA | Poster #33
Presenting Team Members: Shayan Ebrahimi , Kouhyar Sheida, Savion Siner [All Electrical Engineering]

NASA began actively working on the Artemis program in 2019, with the goal of returning humans to the Moon by 2025 and establishing a sustainable presence on the lunar surface. In addition to Artemis, NASA is planning on developing new technologies and capabilities that will enable long-duration human spaceflights, such as advanced life support systems, in-situ resource utilization, and 3D printing. This mission would not be possible without an available, reliable, autonomous, and resilient power system. Space-based power systems are different than earth's grid in terms of generation sources, needs, structure, and controllability. The overall goal of this project is to enhance system health management and situational awareness in space power systems. With that said, two research objectives are set including 1) improved model fidelity, and 2) enhanced communication and control between physical plant and the model. Specific research activities are designed to meet the two objectives along with expected outcomes (short term and beyond the project's life). The project involves both simulation and experiments. I will be working with NASA Stennis Space Research Center and NASA Glenn Research Centers as my collaborators. There will be one undergraduate student and one graduate student involved in this project assisting me with different research activities.

“Spark Plasma Heat Treatment of Metallic Parts Made by Laser Powder Bed Fusion Additive Manufacturing”

Edem Honu | Southern University and A & M College (SUBR) | REA | Poster #34
Presenting Team Members: Edem Honu (Mechanical Engineering), Braylen Titus (Civil Engineering)

To eliminate the defects with irregular shapes inside metallic parts made by L-PBF, heat treatments are necessary. Hot isostatic pressing (HIP) is the most prevalent heat treatment strategy used by NASA currently to alleviate the detrimental effects of defects on the parts performance. However, HIP has its drawbacks, such as extended cycle time, elevated costs, and safety concerns. In comparison, spark plasma sintering (SPS) heat treatment shows the promising features of both time and energy savings. SPS is commonly used to sinter metallic powders into consolidated parts to achieve rapid heating and cooling rates along with a brief temperature-pressure holding time. This technique utilizes a combination of electrical current and uniaxial compression pressure to facilitate swift densification, leading to the production of high-quality and high-performance materials. The concept of SPS for heat treatment to eliminate defects stems from the typical process involved in powder consolidation, where when current passes through the sintering die, the die is heated up, which simultaneously heats up the powders. When a spark discharge appears in a gap or at the contact point between the powders, a local high-temperature state (up to 10,000 °C) is generated, causing evaporation and consolidation of the surfaces of the powders by accelerating the mass transfer process to form sintering necks between the powders. Drawing from this concept, when a pore or microcrack is subjected to a SPS process, sparks would be generated in the gap regions of the pores or microcracks. Subsequently, this would create extremely localized high temperatures, which would accelerate mass transfer to fill the defects’ sharp edges, analogous to the formation of sintering necks to aid in powder consolidation.

Thus, in this present study, spark plasma heat treatment was utilized for heat-treating metallic components produced using LPBF for improved mechanical performance and with the objective of achieving properties comparable to those of samples treated using the HIP method. The preliminary investigation was carried out as follows: spark plasma heat treatments were performed on a high-chromium nickel-based superalloy made with LPBF with the following profile: the sample was heated from room temperature to a high temperature of 1100°C (with the material's melting point being approximately 1360 °C) at a rate of 100 ℃/min. After maintaining this temperature for 5 minutes, the sample was then cooled down to room temperature within the furnace. The microstructures and mechanical behaviors of the L-PBF sample before and after heat treatment were analyzed. From transmission electron microscopy (TEM) results, there were significant changes in the microstructures, including the transformation of irregular-shaped pores to spherical-shaped ones and more defined grain boundaries. Positron annihilation lifetime spectroscopy (PALS) tests revealed a considerable reduction in atomic-level defects after spark plasma heat treatment. Lastly, tensile stress-strain curves highlighted the changes in mechanical behaviors post-heat treatment, specifically a decrease in alloy strength and a substantial improvement in ductility, likely due to defect removal (atomic level) and defect shape alteration (micro-scale). The preliminary study has shown conclusively that spark plasma heat treatment can be utilized to tailor and improve the properties of L-PBF components by modifying their microstructures.

Currently, ongoing investigations involve the study of the microstructure and mechanical properties of SPS-heat-treated Ti-6AL-4V (Ti64) alloys fabricated by LPBF. In the study, Ti64 alloy samples were heated from room temperature to the sintering (hold) temperature at a rate of 100 ℃/min. The sintering temperatures and their corresponding holding times in parenthesis were as follows: 900 ℃ (5 mins), 1000 ℃ (5mins), 1000 °C (10 mins), 1000 ℃ (15 mins), 1100 ℃ (5 mins). Subsequent studies would involve utilizing advanced material characterization tools, such as scanning electron microscopy (SEM), TEM, and X-ray diffraction (XRD) to assess the evolution of defects and the micrsocstructure of SPS heat-treated samples. Mechanical tensile testing would also be performed to assess the mechanical performance of heat-treated samples. Lastly, thermodynamic modeling will be utilized to explore the optimal spark plasma heat treatment processing windows for heat treatments.

"A self-charging piezoelectric zinc-ion battery for self-power capability in space"

Abhishek Paudel | Louisiana State University and A&M College (LSU) | REA | Poster #35
Presenting Team Members: Abhishek Paudel (Mechanical Engineering)

We developed a self-charging zinc-ion battery using a PVDF-ZnO piezoelectric separator placed in a hydrogel electrolyte. This battery captures energy from tapping, removing the need for external charging, and offers sustainable energy storage. It works by converting mechanical energy into electrical energy through tapping, maintaining a stable potential over time. When connected in series, multiple batteries can generate higher voltages. This is the first report of such a piezoelectric self-charging zinc-ion battery, which can be used in space and is well-suited for sustainable, safe energy solutions in wearable electronics.

"Al6061/Al7075 Dissimialr Metal Joint Made with Additive Friction Stir Deposition"

Kekeli Agbewornu | Southern University and A & M College (SUBR) | REA | Poster #36
Presenting Team Members: Kekeli Agbewornu (Mechanical Engineering), Antonio Wells (Mechanical Engineering)

Dissimilar metal joints amalgamate the unique attributes of different metals, fostering innovations in manufacturing and design by harnessing their combined properties. However, the integration of metals with disparate characteristics introduces challenges, such as variations in melting points, thermal expansion coefficients, and chemical compatibilities. Traditional joining techniques like welding, brazing, soldering, diffusion bonding, friction stir welding, and laser joining each present limitations, such as the formation of brittle intermetallic compounds, difficulty in finding effective filler materials, stringent parameter controls, and high residual stresses.

Additive Friction Stir Deposition (AFS-D) emerges as a promising solid-state additive manufacturing technique addressing these issues. AFS-D effectively reduces porosity, hot cracking, elemental segregation, and aggregation of oxide particles while enabling near-net shaping, thus minimizing pre- and post-processing needs. It produces refined microstructures with uniform mechanical properties and high deposition rates, making it suitable for a broad range of engineering alloys and composites.

This study explores the use of Additive Friction Stir Deposition (AFS-D) to join Al6061 and Al7075 alloys, addressing challenges related to dissimilar metal joints. AFS-D effectively reduces porosity, hot cracking, and elemental segregation, enabling near-net shaping with minimal pre- and post-processing. The research focuses on optimizing processing parameters and investigating the hardness, composition distribution, corrosion resistance, and effects of heat treatment on the joints. Initial findings show successful bonding with no visible defects. Hardness tests reveal consistent profiles across the joint, while EDS and SEM analyses confirm homogeneous composition distribution. Corrosion tests demonstrate improved resistance compared to traditional

"Improvement of 3D printing setup for freeform fiber-reinforced photopolymer structures"

Mizuki Teruyama | Louisiana State University and A&M College (LSU) | REA, LURA | Poster #37
Presenting Team Members: Mizuki Teruyama (Mechanical Engineering)

The use of lightweight composites can potentially optimize material development for space travel by lowering production cost and material weight. The incorporation of continuous fiber reinforcement within photopolymer resin printing will create free-standing structures that can sustain harsh space environments and in-space manufacturing due to its high stiffness and strength. Furthermore, it could optimize NASA's use of materials in space by allowing for rapid prototyping on long-duration missions. This project will be conducted on an Ender V3 3D printer that has been modified to extrude photopolymer resin with UV light attachments. Preliminary results will be reported on extrusion experiments that have been conducted to determine the ideal parameters for free-standing structures considering UV light intensity, extrusion pressure, and G-code speed. This 3D printing setup will be improved by automating and coordinating control of resin extrusion and UV light with the G-code during the printing process using an Arduino UNO. Future steps include a syringe dispenser mechanism that will be designed to allow small scale printing of continuous fiber-reinforced photopolymers. This project focuses on the automation of the 3D printing setup and in-situ impregnation of continuous fibers, but the overarching goal is the optimization of material development in space travel.

“Machine Learning and Its Applications In Image Processing”

Knykolas Ross | Southern University and A & M College (SUBR) | HIS / Timbuktu Academy | Poster #38
Presenting Team Members: Knykolas Ross

The supreme basis of my research with Crest is Machine Learning. I have no experience or knowledge with machine learning prior to this spring semester. So, the first step was to gain the necessary background knowledge in order to assist my mentor in their research project. This included correcting information I falsely held as true. Although often used interchangeably, artificial Intelligence and machine learning are not the same thing, but two things closely related to one another. Artificial intelligence is the science of programming machines to make them capable of tasks that usually require human intelligence. Machine learning is a subset of artificial intelligence that utilizes algorithms in order for the machine to make judgements from the data provided. Deep learning is another commonly associated term. It is a subset of machine learning that uses neural networks to solve complex problems. These neural networks have a similar structure to the human brain. Machine learning has applications in various fields and areas such as fraud detection, self-driving cars, medical diagnosis, and advertisements. The purpose of our research is to dive deep into practical applications for machine learning in the field of agriculture. We want to develop sensors that can aid in the cultivation of crops. Ideally, our sensors will help calculate soil fertility, soil moisture, its temperature, and the light intensity. These measurements will aid us in creating the ideal situations for agricultural cultivation. In addition to sensors, we will also use image processing to help in harvesting them at the optimal time as well as sorting them once ripe.

“Multifunctional Soft Materials towards Seals with Embedded Electronics for Space Applications”

Olutofunmi Olaoye | Louisiana State University and A&M College (LSU) | REA, LURA, RAP | Poster #39
Presenting Team Members: Olutofunmi N Olaoye (Industrial Engineering,) Gabriel B Freedman(Mechanical Engineering,) Michael D Ruiz(Mechanical Engineering,) Caleb M Reid (Mechanical Engineering)

Seals are an integral component to maintaining the operation and longevity of equipment in a space environment, affecting both mechanical performances and astronaut safety. To enhance the longevity and reliability of seals, we aim to embed electronics into seals to offer monitoring and lunar dust mitigation capabilities. Using a set of liquid metal (LM), silver flake (Ag), and fluoroelastomer (FKM) material systems, soft electronics are embedded within elastomeric seals while maintaining key seal properties. Soft sensors are developed to measure degradation and compression of a seal. In addition, we aim to embed electrodes for electrodynamic dust shielding of lunar dust. Through a series of material characterizations, we optimize the composition of a Viton-based material system for soft electronics and validate suitability as seal materials. With the use of molding and printing techniques, elastomeric seals with embedded electronics are fabricated. This work will advance seal technology by providing monitoring and dust mitigation technology to support the performance and reliability of future in-space systems. Future work will focus on optimizing sensor response, studying material performance in extreme conditions, and demonstrating dust mitigation.

“Forbidden Decays”

Karriem Upshaw | Southern University and A & M College (SUBR) | HIS / Timbuktu, LSLamp | Poster #40
Presenting Team Members: Justin Mitchell (Physics), Treston Egby (Physics)

Using air shower simulators to simulate forbidden decay chains.

"LOUIS: Autonomous Planetary Rover Optimized for Rough Terrain Exploration"

Pranav Pothapragada | Louisiana State University and A&M College (LSU) | REA,Senior Design | Poster #41
Presenting Team Members: Pranav Pothapragada(Electrical Engineering)

LOUIS (Land Optimized Upgradable Interplanetary System) presents a scalable and robust design for an autonomous planetary rover optimized for rough terrain exploration. This project aims to provide a scalable platform for advancing research in autonomous planetary exploration. The rover is designed and implemented with a 6-wheel "Rocker-Bogie" suspension, ensuring stability on uneven surfaces. The setup is powered by a lightweight lithium-ion battery, allowing for over 60 minutes of continuous operation. LOUIS is designed to include key features such as real-time obstacle detection, communication systems for autonomous navigation, and real-time data transmission. The implemented rover weighs 77.25 kg, operates at a speed of 3 mph, and supports a carrying capacity of 36 kg, which allows for future expansions. Potential improvements to the system are considering integrating solar power systems to extend operational time and enhance autonomous control for navigating more complex terrains and mission scenarios.